Running head: AMS in patients with SSD

The specificity of health-related autobiographical memories in patients with somatic symptom disorder

Marta Walentynowicz, MA[1]

Filip Raes, PhD[2]

Ilse Van Diest, PhD[1]

Omer Van den Bergh, PhD[1]

[1]Health Psychology, University of Leuven, Leuven

[2]Learning Psychology and Experimental Psychopathology, University of Leuven, Leuven

Total number of words: 5321

Number of tables: 2

Number of figures: 0

Conflicts of Interest and Source of Funding: None of the investigators have any conflicts of interest.

Corresponding author:

Omer Van den Bergh, PhD

Health Psychology

University of Leuven

Tiensestraat 102 – box 3726, 3000 Leuven, Belgium.

Tel.: +32-(0)16-32.60.58, Fax: +32-(0)16-32.61.44.

Email: omer.vandenbergh@ppw.kuleuven.be

Abstract

Objective

Reduced autobiographical memory specificity (rAMS) is related to a range of emotional disorders and is considered a vulnerability factor for an unfavorable course of pathology. The present study investigated whether the specificity of health-related autobiographical memories is reduced in patients with somatic symptom disorder (SSD) with medically unexplained dyspnea complaints, compared to healthy controls. Patients with SSD have persistent distressing somatic symptoms that are associated with excessive thoughts, feelings, and behaviors.

Methods

Female SSD patients (n = 30) and matched healthy controls (n = 24) completed a health-related Autobiographical Memory Test, the Beck Depression Inventory, the Ruminative Response Scale, and rumination scales concerning bodily reactions. Depressive symptoms and rumination were assessed because both variables previously showed associations with rAMS.

Results

Patients with SSD recalled fewer specific ($F(1, 52) = 13.63$, $p = .001$) and more categoric ($F(1, 52) = 7.62$, $p = .008$) autobiographical memories to health-related cue words than healthy controls. Patients also reported higher levels of depressive symptoms and rumination (all ts > 3.00, ps < .01). Importantly, the differences in memory specificity were independent of depressive symptoms and trait rumination.

Conclusions

The present study extends findings on rAMS to a previously unstudied sample of patients with SSD. Importantly, the presence of rAMS could not be explained by increased levels of depressive symptoms and rumination. We submit that rAMS in

this group reflects how health-related episodes and associated symptoms are encoded in memory.

Keywords: autobiographical memory specificity, somatic symptom disorder, rumination

Abbreviations List

AMS	Autobiographical Memory Specificity
AMT	Autobiographical Memory Test
CaR-FA-X	Capture and Rumination – Functional Avoidance – eXecutive control
BDI-II	Beck Depression Inventory-II
BMI	Body Mass Index
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
h-AMS	Autobiographical Memory Specificity for health-related cue words
h-AMT	Health-related Autobiographical Memory Test
h-RRS	Health-related Ruminative Response Scale
MUD	Medically Unexplained Dyspnea
OGM	Overgeneral Memory
PTSD	Posttraumatic Stress Disorder
rAMS	reduced Autobiographical Memory Specificity
RRS	Ruminative Response Scale
SD	Standard Deviation
SSD	Somatic Symptom Disorder

According to the recent DSM-5 (1), somatic symptom disorder (SSD) is characterized by persistent distressing somatic symptoms which are associated with disproportionate and excessive feelings, thoughts, and behaviors, and that result in substantial disruption of functioning. In many cases, patients with SSD report symptoms that cannot be explained by a physiologic dysfunction.

Studies focusing on perceptual-cognitive processes in patients with SSD and in persons scoring high for habitual symptom reporting unrelated to disease showed specific characteristics distinguishing them from healthy persons (2,3). First, sensory-perceptual processing of somatic information tends to be less detailed, as suggested by (a) the absence of peak-end heuristic for somatic episodes (which states that symptom evaluation is predominantly influenced by the most intense (peak) and the final (end) moments and less so by the duration; 4); (b) diminished correspondence between self-reported complaints and related physiological reactions (5); and (c) poorer differentiation between various somatic sensations and stronger influence of earlier knowledge during categorization (6). Second, negative emotional responses to bodily stimuli are more intense in these groups (7,8) and seem to mediate the observed overreporting of recalled symptoms (7). Focusing on the affective information at the expense of detailed encoding of sensory-perceptual features of somatic episodes can influence the way bodily symptoms are remembered, which may manifest itself in reduced specificity of retrospective memory.

The difficulty to retrieve specific personal memories of a past event, termed as reduced Autobiographical Memory Specificity (rAMS) or Overgeneral Memory (OGM) was previously found in a range of psychopathological disorders, most importantly depression and PTSD (see 9). Memory specificity is typically assessed

using an emotional cue-word procedure, known as the Autobiographical Memory Test (AMT; 10). Especially depressed patients find it difficult to retrieve specific memories on the AMT. More often than healthy controls, they recall non-specific or overgeneral memories (e.g., “every time other people hurt me” to the cue ‘disappointed’) rather than the requested specific memories (e.g., “three weeks ago, when John called to tell me he would not be coming over for my birthday”). rAMS (or OGM) is not only a concomitant of depression, but is also considered as a relatively stable marker of an unfavorable course of psychopathology, impacting severity of symptoms, illness duration, and treatment success (see 11 for a review and meta-analysis).

According to the CaR-FA-X model (9; see also 12,13), three mechanisms contribute to rAMS, alone or in interaction: Capture and Rumination (CaR), Functional Avoidance (FA) and impaired eXecutive control (X). The first factor (CaR) refers to situations in which memory retrieval is disrupted and ‘captured’ at a more general level in the memory hierarchy (see Self-Memory Model; 14). In such instances, highly self-relevant cue words may activate networks of self-related ‘general’ information, which hinder the retrieval of specific memories (15) as observed in clinical groups (16,17). Moreover, rumination, in the form of analytical and abstract repetitive thinking (or “brooding”; 18) has been shown to further promote this capture, as demonstrated by correlational (13,19) and experimental studies (e.g., 20–23). Consequently, one remains ‘stuck’ in a cyclic retrieval of general self-related information, and progression towards more concrete, specific memory content is delayed. Second, functional avoidance occurs when specific recollections of adverse experiences are avoided in order to reduce the impact of negative affect associated with those memories (9). In line with this affect-regulation

hypothesis, rAMS is associated with avoidant coping styles as assessed by a variety of avoidance measures (24,25). While in the short-term, a less specific retrieval style may be more functional and beneficial, as it is related to a lower emotional distress to a mild aversive experience (26–28), this general retrieval style may become maladaptive when used for a longer time (9). The final 'X'-factor relates to the impairments in executive resources that prevent successful retrieval of specific memories, including the deficits in working memory capacity, inhibition, and verbal fluency (29).

Patients with SSD respond to the experience of somatic symptoms with maladaptive thoughts and emotions, which can affect perceptual and mnemonic processes related to bodily sensations in different ways. With regard to symptom perception, the tendency to experience symptoms as intense, noxious, and disturbing may result in an increased attentional focus to somatic changes, leading to increased perception of bodily sensations and symptom reporting, as postulated by the theory of somatosensory amplification (30). However, in case of memory retrieval, the functional avoidance hypothesis (CaR-FA-X model; 9) suggests that the specific recollections of aversive events are avoided as a means of affect regulation. Consequently, because patients perceive somatic experiences as threatening and aversive, they may be more inclined to avoid retrieving highly specific details of those memories, as these would evoke associated anxiety and intense negative emotions. As a result, reduction of symptom-related distress could be achieved at the expense of memory specificity. Such functional avoidance, together with less detailed sensory processing described above, could lead to rAMS in this patient group. However, until now this aspect of memory in SSD patients has not been investigated.

The purpose of the present study was to investigate the specificity of autobiographical memory in patients with SSD. It was previously shown that the cues relevant to one's concerns tend to prompt overgeneral memories (17,31). Accordingly, cue words associated with health were used to elicit the retrieval of specific health-related autobiographical memories, which were assumed to be highly relevant to this group. Moreover, because comorbid emotional disorder is often associated with SSD (32), we also assessed depression and rumination in order to control for these variables. We hypothesized that patients will retrieve fewer specific and more categoric autobiographical memories in response to health-related cues compared to controls. The focus was placed on those indices of rAMS, because previous research has shown that among the non-specific memories the categoric 'subtype' is a marker of pathology or vulnerability for pathology (e.g., 33,34). In addition, we also expected higher levels of rumination and depression in the patient (vs. control) group.

Method

Participants

The data used in this sample are derived from a larger two-part questionnaire and experimental study investigating memory for dyspnea in patients with SSD who particularly suffered from Medically Unexplained Dyspnea (MUD; n = 30; all women). Healthy controls were matched for age, gender, BMI, and educational level (n = 24; all women). Patients were recruited from the outpatient pulmonology clinic of the Leuven University Hospital (Gasthuisberg) and were classified as having MUD after (1) a systematic medical work-up procedure which excluded physiological causes for the multiple somatic complaints such as dyspnea, breathing distress, fatigue, and numbness; and (2) a systematic interview, namely the Structured Clinical Interview

for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Axis I Disorders, administered by a qualified psychologist, which excluded psychiatric reasons for experienced dyspnea other than somatization disorder. The assessment of psychological criteria of SSD was based on the new classification criteria of DSM-5 (1). A validated instrument to directly measure the psychological characteristics of SSD became only recently available (35). Exclusion criteria included a self-reported history of pulmonary, cardiovascular, gastrointestinal, or neuromuscular disease, or other medical conditions that likely affect respiratory capacity, such as acute illnesses, fever, or flu. Participants were also excluded if they currently suffered from mental disorders other than SSD (self-reported via a general item), were pregnant or lactating. Five patients reported used of medication, including proton-pump inhibitors (pantoprazole), beta blockers (propranolol), selective serotonin reuptake inhibitors (escitalopram, sertraline), and benzodiazepines (alprazolam). Because the inclusion or exclusion of the medication-taking patients did not influence the results of the study, these patients were retained in the final sample. The study was approved by The Medical Ethics Committee of the University Hospital of the University of Leuven and took place between August 2012 and April 2014.

Measures

Health-related Autobiographical Memory Task (h-AMT). Autobiographical Memory Specificity (AMS) for health-related cue words (h-AMS) was assessed with use of the Autobiographical Memory Test (10) adapted for health-related memories. Five positive (*recover*, *health*, *cure*, *vaccination*, *treatment*) and five negative (*disease*, *flu*, *feverish*, *bacterium*, *headache*) health-related cue words were presented in alternating order. The two word groups were selected and matched on emotional extremity, imageability, familiarity and relatedness to health, following a

two-step procedure: First, a pool of potential health-related cue words was generated (n = 78). Second, a sample of undergraduate psychology students (n = 141) rated each item on valence, imageability, familiarity, and relatedness to health/illness. Six words were repeated (reliability test). A list of 5 positive and 5 negative words that were matched for all the rated characteristics was constructed. Participants were instructed to recall a specific event related to the cue word, which was read aloud by the researcher. A specific memory was defined as a memory about a personally experienced event that happened at a particular time and place and that lasted less than 1 day. Then, examples of both specific and overgeneral memories were provided. Three practice words (*relaxation*, *doctor*, *active*) were used before the test to familiarize participants with the procedure. The time given to retrieve a specific memory to each cue was 60 s and the responses were audiotaped. If the answer was non-specific, the participants were prompted to retrieve a memory of a specific event. In case of an ambiguous response, a clarification question was asked. The complete Dutch instructions together with the English translation are included in the Supplementary Digital Content 1.

Responses were coded as specific if they referred to a personal memory of an event, which happened more than 7 days before the testing day and lasted less than one day. Otherwise, the memories were coded as non-specific and further subdivided into overgeneral categoric (events occurring more than once, e.g. “Every time when I went to physiotherapist”), overgeneral extended (events lasting more than one day, e.g. “When I was recovering after the surgery”), same events, omissions (no response provided), and no memories (responses not referring to the past; associations or references to the future). In line with previous studies (9,36), specific and categoric first memories were used as indices of rAMS. For inter-rater

reliability, a random sample of audiotaped responses of 20 participants (37%) was evaluated by an independent rater blind to participant's group. There was high agreement between the two raters (κ = .845).

Depression. Depressive symptoms were measured with the Dutch version of Beck Depression Inventory-II (BDI-II; 37). This 21-item questionnaire uses a 0-3 scale to assess current cognitive, affective and physical symptoms of depression. Cronbach's α in the present sample was .92.

Rumination on sadness. Ruminative thinking in response to sad and depressed mood was assessed with the brooding subscale of Ruminative Response Scale (RRS; 20, see also 21). Responses to five items describing thoughts about possible causes and consequences of one's mood are given on 4-point Likert scale (*almost never* to *almost always*). The Dutch version was used (39,40). Cronbach's α in the present sample was .62.

Rumination on bodily reactions. The modified RRS was used to measure ruminative responses to bodily sensations and symptoms. In the adapted version (h-RRS) participants rated the frequency of thoughts regarding possible causes, meanings, and consequences in response to bodily sensations and symptoms. Similarly to the RRS (18), the h-RRS consists of two factors: body brooding and body reflection. Details concerning items and scale construction are described in the Supplemental Digital Content 2. Both subscales were reliable in the present study, with Cronbach's α of .93 for brooding and .87 for reflection.

Procedure

Participants were invited to a study investigating the influence of respiratory challenges on breathing behavior and subjective well-being. The study consisted of two unrelated parts: a questionnaire study and an experimental study. The latter part

is beyond the scope of the present paper and is reported separately (manuscript in preparation). Before the laboratory session, participants completed a series of trait questionnaires at home, including the BDI-II. Other administered questionnaires including the Checklist for Symptoms in Daily Life (41), the Positive and Negative Affect Schedule (42), and the Perseverative Thinking Questionnaire (43) are not reported in this manuscript. In the laboratory, each patient was informed about the procedure and signed the informed consent. After completing the demographic information sheet, the questionnaire study took place, during which the h-AMT was administered in an oral form, followed by the trait rumination questionnaires. Once completed, the experimental study followed.

Statistical analyses

The group differences in demographic variables and trait measures were compared using independent sample *t* tests for continuous data and χ^2 tests for categorical data. Group differences in memory specificity were examined with 2 (Group: patients/controls) × 2 (Cue valence: positive/ negative) mixed-design analyses of variance.

Multiple mediator models were applied to specific and categoric memories to examine whether the group differences in rAMS could be attributed to the differences in psychological characteristics known to be closely related to rAMS (i.e. depression and rumination). Instead of performing multiple testing with a series of simple mediation models, multiple mediator models were used in which the mediators are included simultaneously in a single integrated model (44). As a result, the estimated effect of a specific mediator is conditional upon the other mediators in the model. To perform the analyses, scores on the BDI-II, RRS-brooding, and h-RRS brooding were simultaneously included as mediators and tested in a single parallel multiple

mediator model using the bootstrapping procedure (45). This procedure, designed for small sample sizes, allowed to estimate the indirect effects of the group on both specific and categoric memories through each of the mediators, as well as the direct effects of the group. The 95% confidence intervals of the effects were derived with 5000 bootstrap re-samples. Direct and indirect effects are reported in unstandardized form (44). Data were analyzed with IBM SPSS Statistics 23 and PROCESS Macro for SPSS (44).

Results

Demographic and personality characteristics of both groups are presented in Table 1. The groups did not differ with regard to demographic characteristics, but patients did score significantly higher on the BDI-II, the RRS-brooding, and both subscales of the h-RRS as compared to controls. Most crucially, group differences emerged also with regard to memory specificity (see Table 2). Patients with SSD, compared to controls, retrieved fewer specific, $F(1,52) = 13.63$, $p = .001$, $\eta_p^2 = .21$, and more categoric memories, $F(1,52) = 7.62$, $p = .008$, $\eta_p^2 = .13$. In line with previous findings indicating unidimensionality of AMT (46), the cue valence had no effect on either specific, $F(1,52) = .77$, $p = .39$, $\eta_p^2 = .02$, or categoric memories, $F(1,52) = 2.09$, $p = .16$, $\eta_p^2 = .04$.

Multiple mediation model

The analyses above showed significant group differences in the indices of rAMS, depressive symptoms, and trait rumination. Moreover, the number of specific memories correlated negatively with depressive symptoms, $r(54) = -.34$, $p = .012$, as well as with brooding on bodily sensations and symptoms, $r(54) = -.34$, $p = .011$ (for a complete list of the unadjusted correlations between the indices of rAMS and the psychological measures, see Supplementary Table 1 in Supplemental Digital

Content 3). To investigate whether the group differences in rAMS could be associated with differences in depression and rumination, multiple mediator models were used.

With regard to specific memories, the bootstrap results indicated that the total effect of group on specific memories (total effect, b = -2.28, *p* = .001, 95% CI [-3.53, -1.04]) remained significant when all mediators were included in the model (direct effect of group, b = -1.76, *p* = .048, 95% CI [-3.51, -0.02]). Moreover, neither the total indirect effect of group on specific memories through the three mediators, nor the specific indirect effects of each of the proposed mediators were significant (all bs < .70, *p*s > .31). Similar results were observed for the multiple mediator model using categoric memories as the dependent variable. The total effect of group on categoric memories (total effect, b = .73, *p* = .008, 95% CI [.20, 1.25]) remained significant when the mediators were included in the model (direct effect of group, b = .76, *p* = .046, 95% CI [.01, 1.51]), with neither total nor specific indirect effects reaching significance (all bs < .14, *p*s > .47). These findings indicate that depressive symptomatology and brooding subscales of rumination did not mediate the relationship between the group and rAMS.

Discussion

Our study investigated memory specificity in SSD patients. The results indicated that our sample of SSD patients show reduced memory specificity when recalling health-related experiences compared to healthy controls. One of the possible explanations of this finding may be related to the way patients with SSD process information about their somatic sensations and complaints. As bodily sensations consist of both sensory-perceptual and affective-motivational components (47–49), SSD patients may encode and store fewer sensory elements

while focusing on the affective features of somatic episodes. In consequence, patients can be expected to experience difficulties in retrieving detailed and specific memories in response to health-related cue words indicating reduced specificity of autobiographical memories for health-related episodes. The first-time observation of rAMS in SSD patients in the current study is consistent with findings showing biased processing of somatic information (4–6), but adds to it that memory processes may also contribute to biased retrospective symptom reporting in clinical interviews and questionnaire-based symptom assessments. Future studies are necessary to investigate whether the rAMS is also a prognostic factor for the onset, maintenance, recurrence of SSD, similar to its role in predicting the course of affective disorders (11).

The well-documented association between depression and rAMS (see 9 for a review) together with the high prevalence rate of comorbid emotional disorder in SSD patients (32) may suggest that the observed deficits in memory specificity originated from increased depressive symptoms in the patient group. However, the relationship between group and rAMS remained significant after controlling for levels of depressive symptoms and trait rumination. This is in line with other studies showing that the retrieval of less specific memories is independent of trait depression in chronic pain (50), in borderline patients (17), and in individuals with a history of child sexual abuse (51).

The current findings also inform about possible mechanisms underlying rAMS in SSD patients. The CaR-FA-X model (9) describes that when self-related information is processed in a ruminative manner, the cognitive resources necessary to perform the memory search are “captured” at more general levels, disrupting the further retrieval of more specific memories. In particular, this effect is found for the

maladaptive form of repetitive thought, i.e. brooding (40,52). The higher levels of rumination observed in our patient group (vs. controls), could therefore suggest '(Capture and) Rumination' as a possible underlying mechanism of rAMS in this group. However, the mediation analyses did not support this interpretation, as neither affective nor health-related brooding mediated this relationship. This suggests that rumination is not a key factor explaining the deficit in memory specificity in this particular group. However, as activation of state ruminative processing may be needed to observe such relationship (22,36), more research is necessary to further delineate this association, since we only relied on a trait measure of different forms of rumination.

According to the Car-FA-X model, factors underlying rAMS can interact or be active to a different extent in different groups. This implies that other mechanisms than rumination, i.e. functional avoidance or executive control could also influence memory specificity in patients with SSD. It was indeed shown that patients with SSD tend to perceive bodily stimuli as more aversive and threatening which may promote avoidance (8). Also deficits in executive control (X), including response inhibition, cognitive flexibility and working memory have been reported in patients qualifying for SSD (53–55).

In the present study, the widely used questionnaires measuring memory specificity (AMT) and rumination (RRS) were tailored to SSD patients. While the adjustment of AMT to health-related context was expected to elicit more OGM (17,31), two consequences of this content adaptation should be mentioned. First, the health-related cue words might be more concrete than the affective ones used in the standard AMT which could have enhanced the retrieval of specific memories (51). Indeed, even though our clinical sample retrieved fewer specific memories in

response to the cue words compared to the control group, the deficits in AMS were less severe than usually observed among depressed/dysphoric individuals. Second, it is uncertain whether rAMS in patients with SSD is limited to health-related word cues or whether it also generalizes to emotional stimuli. However, as the assumptions of CaR-FA-X model are based on more general memory mechanisms, we would predict that similar memory specificity effects would appear regardless of the cue-word used.

In sum, this study is the first to report a deficit in memory specificity for health-related cues in patients with SSD. Importantly, this relationship could not be attributed to increased levels of depressive symptoms and rumination in the patient group. While rAMS could affect the way health-related episodes and associated symptoms are remembered, future research is necessary to replicate this and to examine which factors underlie this pattern of retrieval.

Acknowledgments

The authors want to thank dr. Tom Van Daele for scoring a subset of the AMTs. The study was funded by Grant OT/10/027 from the University Research Council of University of Leuven.

References

1. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric Publishing; 2013.
2. Rief W, Martin A. How to Use the New DSM-5 Somatic Symptom Disorder Diagnosis in Research and Practice: A Critical Evaluation and a Proposal for Modifications. Annu Rev Clin Psychol 2014;10:339–67.
3. Van den Bergh O, Bogaerts K, Van Diest I. Symptom Perception, Awareness and Interpretation. In: Wright JD, editor. International Encyclopedia of the Social & Behavioral Sciences 2nd ed. Oxford, UK: Elsevier; 2015. p. 866–72.
4. Bogaerts K, Wan L, Diest I Van, Stans L, Decramer M, Van den Bergh O. Peak-end memory bias in laboratory-induced dyspnea. Psychosom Med 2012;74:974–81.
5. Bogaerts K, Van Eylen L, Li W, Bresseleers J, Van Diest I, De Peuter S, Stans L, Decramer M, Van den Bergh O. Distorted symptom perception in patients with medically unexplained symptoms. J Abnorm Psychol 2010;119:226–34.
6. Petersen S, Van Staeyen K, Vögele C, von Leupoldt A, Van den Bergh O. Interoception and symptom reporting: Disentangling accuracy and bias. Front Psychol 2015;6:732.
7. Walentynowicz M, Bogaerts K, Van Diest I, Raes F, Van den Bergh O. Was It So Bad? The Role of Retrospective Memory in Symptom Reporting. Heal Psychol 2015;34:1166–74.
8. Wan L, Stans L, Bogaerts K, Decramer M, Van den Bergh O. Sensitization in medically unexplained dyspnea: differential effects on intensity and unpleasantness. Chest 2012;141:989–95.
9. Williams JMG, Barnhofer T, Crane C, Herman D, Raes F, Watkins E, Dalgleish

T. Autobiographical memory specificity and emotional disorder. Psychol Bull 2007;133:122–48.

10. Williams JMG, Broadbent K. Autobiographical memory in suicide attempters. J Abnorm Psychol 1986;95:144–9.
11. Sumner JA, Griffith JW, Mineka S. Overgeneral autobiographical memory as a predictor of the course of depression: A meta-analysis. Behav Res Ther 2010;48:614–25.
12. Sumner JA. The mechanisms underlying overgeneral autobiographical memory: An evaluative review of evidence for the CaR-FA-X model. Clin Psychol Rev 2012;32:34–48.
13. Sumner JA, Mineka S, Adam EK, Craske MG, Vrshek-Schallhorn S, Wolitzky-Taylor K, Zinbarg RE. Testing the CaR–FA–X model: Investigating the mechanisms underlying reduced autobiographical memory specificity in individuals with and without a history of depression. J Abnorm Psychol 2014;123:471–86.
14. Conway MA, Pleydell-Pearce CW. The construction of autobiographical memories in the self-memory system. Psychol Rev 2000;107:261–88.
15. Dalgleish T, Tchanturia K, Serpell L, Hems S, Yiend J, de Silva P, Treasure J. Self-reported parental abuse relates to autobiographical memory style in patients with eating disorders. Emotion 2003;3:211–22.
16. Crane C, Barnhofer T, Williams JMG. Cue self-relevance affects autobiographical memory specificity in individuals with a history of major depression. Memory 2007;15:312–23.
17. Spinhoven P, Bockting CLH, Kremers IP, Schene AH, Williams JMG. The endorsement of dysfunctional attitudes is associated with an impaired retrieval

of specific autobiographical memories in response to matching cues. Memory 2007;15:324–38.

18. Treynor W, Gonzalez R, Nolen-Hoeksema S. Rumination reconsidered: A psychometric analysis. Cognit Ther Res 2003;27:247–59.
19. Debeer E, Hermans D, Raes F. Associations between components of rumination and autobiographical memory specificity as measured by a Minimal Instructions Autobiographical Memory Test. Memory 2009;17:892–903.
20. Watkins E, Teasdale JD. Rumination and overgeneral memory in depression: Effects of self-focus and analytic thinking. J Abnorm Psychol 2001;110:333–57.
21. Watkins E, Teasdale JD. Adaptive and maladaptive self-focus in depression. J Affect Disord 2004;82:1–8.
22. Crane C, Barnhofer T, Visser C, Nightingale H, Williams JMG. The effects of analytical and experiential rumination on autobiographical memory specificity in individuals with a history of major depression. Behav Res Ther 2007;45:3077–87.
23. Raes F, Watkins E, Williams JMG, Hermans D. Non-ruminative processing reduces overgeneral autobiographical memory retrieval in students. Behav Res Ther 2008;46:748–56.
24. Debeer E, Raes F, Williams JMG, Hermans D. Context-dependent activation of reduced autobiographical memory specificity as an avoidant coping style. Emotion 2011;11:1500–6.
25. Hermans D, Defranc A, Raes F, Williams JMG, Eelen P. Reduced autobiographical memory specificity as an avoidant coping style. Br J Clin Psychol 2005;44:583–9.

26. Hermans D, De Decker A, De Peuter S, Raes F, Eelen P, Williams JMG. Autobiographical memory specificity and affect regulation: Coping with a negative life event. Depress Anxiety 2008;25:787–92.
27. Raes F, Hermans D, de Decker A, Eelen P, Williams JMG. Autobiographical memory specificity and affect regulation: An experimental approach. Emotion 2003;3:201–6.
28. Raes F, Hermans D, Williams JMG, Eelen P. Reduced autobiographical memory specificity and affect regulation. Cogn Emot 2006;20:402–29.
29. Dalgleish T, Williams JMG, Golden A-MJ, Perkins N, Barrett LF, Barnard PJ, Yeung CA, Murphy V, Elward R, Tchanturia K, Watkins E. Reduced specificity of autobiographical memory and depression: the role of executive control. J Exp Psychol Gen 2007;136:23–42.
30. Barsky AJ, Wyshak G. Hypochondriasis and somatosensory amplification. Br J Psychiatry 1990;157:404–9.
31. Barnhofer T, Crane C, Spinhoven P, Williams JMG. Failures to retrieve specific memories in previously depressed individuals: Random errors or content-related? Behav Res Ther 2007;45:1859–69.
32. Henningsen P, Zimmermann T, Sattel H. Medically unexplained physical symptoms, anxiety, and depression. Psychosom Med 2003;65:528–33.
33. Barnhofer T, Jong-Meyer R, Kleinpaß A, Nikesch S. Specificity of autobiographical memories in depression: An analysis of retrieval processes in a think-aloud task. Br J Clin Psychol 2002;41:411–6.
34. Williams JMG, Dritschel BH. Categoric and Extended Autobiographical Memories. In: Conway MA, Rubin DC, Spinnler H, Wagenaar WA, editors. Theoretical Perspectives on Autobiographical Memory Dordrecht, The

Netherlands: Kluwert; 1992. p. 391–410.

35. Toussaint A, Murray AM, Voigt K, Herzog A, Gierk B, Kroenke K, Rief W, Henningsen P, Löwe B. Development and Validation of the Somatic Symptom Disorder–B Criteria Scale (SSD-12). Psychosom Med 2016;78:5–12.

36. Raes F, Schoofs H, Griffith JW, Hermans D. Rumination relates to reduced autobiographical memory specificity in formerly depressed patients following a self-discrepancy challenge: The case of autobiographical memory specificity reactivity. J Behav Ther Exp Psychiatry 2012;43:1002–7.

37. Van der Does AJW. Handleiding bij de Nederlandse bewerking van de BDI-II [Manual of the Dutch version of the BDI-II]. San Antonio, Texas/Lisse, The Netherlands: The Psychological Corporation/Swets Test Publishers; 2002.

38. Griffith JW, Raes F. Factor Structure of the Ruminative Responses Scale. Eur J Psychol Assess 2014;1–7.

39. Raes F, Schoofs H, Hoes D, Hermans D, Van Den Eede F, Franck E. “Reflection” en “brooding” als subtypes van rumineren: een herziening van de Ruminative Response Scale [Reflection and brooding as subtypes of rumination: a revision of the ruminative response scale]. Gedragstherapie 2009;42:205–14.

40. Schoofs H, Hermans D, Raes F. Brooding and Reflection as Subtypes of Rumination: Evidence from Confirmatory Factor Analysis in Nonclinical Samples using the Dutch Ruminative Response Scale. J Psychopathol Behav Assess 2010;32:609–17.

41. Wientjes CJ, Grossman P. Overreactivity of the psyche or the soma? Interindividual associations between psychosomatic symptoms, anxiety, heart rate, and end-tidal partial carbon dioxide pressure. Psychosom Med

1994;56:533–40.

42. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: The PANAS scales. J Pers Soc Psychol 1988;54:1063–70.

43. Ehring T, Zetsche U, Weidacker K, Wahl K, Schönfeld S, Ehlers A. The Perseverative Thinking Questionnaire (PTQ): Validation of a content-independent measure of repetitive negative thinking. J Behav Ther Exp Psychiatry 2011;42:225–32.

44. Hayes AF. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. Guilford Press; 2013.

45. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav Res Methods 2008;40:879–91.

46. Griffith JW, Sumner JA, Debeer E, Raes F, Hermans D, Mineka S, Zinbarg RE, Craske MG. An item response theory/confirmatory factor analysis of the Autobiographical Memory Test. Memory 2009;17:609–23.

47. Craig AD. A new view of pain as a homeostatic emotion. Trends Neurosci 2003;26:303–7.

48. Leventhal H, Brown D, Shacham S, Engquist G. Effects of preparatory information about sensations, threat of pain, and attention on cold pressor distress. J Pers Soc Psychol 1979;37:688–714.

49. Price DD. Psychological and Neural Mechanisms of the Affective Dimension of Pain. Science 2000;288:1769–72.

50. Liu X, Liu Y, Li L, Hu Y, Wu S, Yao S. Overgeneral Autobiographical Memory in Patients with Chronic Pain. Pain Med 2014;15:432–9.

51. Hauer BJA, Wessel I, Geraerts E, Merckelbach H, Dalgleish T. Autobiographical memory specificity after manipulating retrieval cues in adults reporting childhood sexual abuse. J Abnorm Psychol 2008;117:444–53.

52. Watkins E. Constructive and unconstructive repetitive thought. Psychol Bull 2008;134:163–206.

53. Correa Á, Miró E, Martínez MP, Sánchez AI, Lupiáñez J. Temporal preparation and inhibitory deficit in fibromyalgia syndrome. Brain Cogn 2011;75:211–6.

54. Aizawa E, Sato Y, Kochiyama T, Saito N, Izumiyama M, Morishita J, Kanazawa M, Shima K, Mushiake H, Hongo M, Fukudo S. Altered Cognitive Function of Prefrontal Cortex During Error Feedback in Patients With Irritable Bowel Syndrome, Based on fMRI and Dynamic Causal Modeling. Gastroenterology 2012;143:1188–98.

55. Solberg Nes L, Roach AR, Segerstrom SC. Executive functions, self-regulation, and chronic pain: A review. Ann Behav Med 2009;37:173–83.

Table 1. Demographic and personality trait characteristics of patients with SSD compared with control group.

Variable	Patients (n = 30)	Controls (n = 24)	Statistics
Mean age (SD)	38.27 (9.03)	37.42 (9.84)	$t(52) = .33$, $p = .74$
Working, *n* (%)	23 (76.7)	20(83.3)	$\chi^2(1, N = 54) = 0.37$, $p = .55$
Marital status, *n* (%)			$\chi^2(3, N = 54) = 0.96$, $p = .81$
Married or co-habiting	19 (63.3)	15 (62.5)	
Single	6 (20)	6 (25)	
Divorced	5 (13.3)	3 (12.5)	
Widowed	1 (3.3)	0 (0)	
Educational level, *n* (%)			$\chi^2(2, N = 54) = 2.88$, $p = .24$
High school	11 (36.7)	4 (16.7)	
College	10 (33.3)	12 (50)	
University	9 (30)	8 (33.3)	
BDI-II (SD)	18.27 (9.34)	5.13 (4.92)	$t(45.67) = 6.64$, $p < .001$
RRS-brooding (SD)	11.33 (2.90)	9.17 (2.01)	$t(52) = 3.10$, $p = .003$
h-RRS brooding (SD)	15.23 (5.11)	9.13 (2.86)	$t(47.09) = 5.55$, $p < .001$
h-RRS reflection (SD)	15.73 (4.00)	12.17 (3.46)	$t(52) = 3.45$, $p = .001$

Note: BDI-II = Beck Depression Inventory; RRS = Ruminative Response Scale; h-RRS = Ruminative Response Scale to bodily sensations and symptoms

Table 2. Means and standard deviations for indices of autobiographical memory specificity by group.

Group	Patients (n = 30)		Controls (n = 24)		Statistics		
	M	SD	*M*	SD	Significant effects	*F* (p)	η_p^2
Specific memories					Group	13.63	.21
Total	7.13	2.87	9.42	1.06		(.001)	
Positive cues	3.73	1.51	4.67	.76			
Negative cues	3.40	1.61	4.75	.53			
Overgeneral categoric memories					Group	7.62	.13
Total	.93	1.17	.21	.59		(.008)	
Positive cues	.33	.55	.13	.45			
Negative cues	.60	.77	.08	.28			
Overgeneral extended memories					Group	8.70	.14
Total	1.00	1.23	.21	.51		(.005)	
Positive cues	.43	.63	.13	.34			
Negative cues	.57	.86	.08	.28			
Same event[a]	.07	.25	.00	.00			
No memory[a]	.63	1.22	.13	.34			
Omission[a]	.23	.63	.04	.20			

[a] For the categories with low response rates only total scores are provided.

List of Supplemental Digital Content:

Supplemental Digital Content 1.pdf

Supplemental Digital Content 2.pdf

Supplemental Digital Content 3.pdf

Supplemental Digital Content 1

AUTOBIOGRAFISCHE GEHEUGENTAAK

Instructies:

Deze test gaat over herinneringen aan gebeurtenissen die je zelf hebt meegemaakt. Ik zal je enkele woorden voorlezen. Het is de bedoeling dat jij bij elk woord je een gebeurtenis probeert te herinneren waaraan dat woord je doet denken. Deze gebeurtenis kan verwijzen naar iets dat recent gebeurd is of heel lang geleden (10 of 15 jaar). Laat ons afspreken dat de gebeurtenis of het moment waaraan het woord je herinnert, moet 'dateren' van minstens zeven dagen geleden. Dus je mag geen gebeurtenissen noemen van de afgelopen zeven dagen. Maar het mag dus ook gaan om iets dat veel langer geleden gebeurd is.

Het kan een belangrijke gebeurtenis zijn of iets triviaals, iets wat niet echt belangrijk was. Wat wel belangrijk is, is dat de herinnering die je vertelt moet verwijzen naar een specifieke gebeurtenis. Met specifiek wordt bedoeld dat de herinnering verwijst naar één welbepaalde gebeurtenis die op een bepaalde dag plaats vond (maar niet langer dan één dag geduurd heeft).

Als ik bijvoorbeeld het woord 'goed' geef, zou je kunnen zeggen 'ik voel me steeds goed op feestjes'. Dit antwoord is echter niet specifiek, het verwijst niet naar één welbepaalde gebeurtenis die op een bepaalde dag plaats vond. Als je zou zeggen 'ik voelde me goed op het laatste feestje bij Veerle' is dit een beter antwoord. Dit is een specifieke gebeurtenis. Je zou ook kunnen antwoorden 'vorige zomer voelde ik me goed', maar dit verwijst naar een gebeurtenis die langer dan één dag geduurd heeft. Een specifieke gebeurtenis daarentegen is iets dat één welbepaalde keer als dusdanig gebeurd is en korter geduurd heeft dan één dag. Het is ook belangrijk dat je bij elk woord steeds een andere herinnering of gebeurtenis noemt. Je mag dus niet tweemaal naar exact eenzelfde gebeurtenis of herinnering verwijzen. Voor we beginnen zal ik eerst drie oefenwoorden geven, om te kijken of alles duidelijk is.

Bij elke cue:
Kan je je één specifiek moment herinneren waar het woord _____ je aan doet denken?

Oefenwoorden: ontspanning, dokter, actief

Stimuluswoorden:

1. ziekte
2. herstel
3. griep
4. gezondheid
5. koortsig
6. genezen
7. bacterie
8. vaccinatie
9. hoofdpijn
10. behandeling

Autobiographical Memory Test

Instructions:

This test inquires about the memories of the events that you have experienced yourself. I will read out some words to you. For each word, I want you to think about an event of which this word makes you think. This event may refer to something that has happened recently or a long time ago (for example 10 or 15 years). Let us agree that the event or the moment of which this word reminds you must have happened at least seven days ago. Thus, you cannot mention the events from the past seven days. But you may also refer to something that has happened much longer ago.

It could be an important event or something trivial, something that was not really important. What is important though is that the memory that you recall should refer to a specific event. It means that it should refer to one particular event that took place on a specific day, but lasted less than one day.

For example, in response to a word “good”, you could say “I always feel good at parties”. However, this response is not specific, because it does not refer to a specific event that took place on a particular day. On the other had, a response “I felt good at the last party at Emma’s” would be a better answer, because it is a specific event. You could also answer "Last summer I felt good”, but this refers to an event that lasted longer than one day. In contrast, a specific event is something that happened at a particular time and place and that lasted less than one day. It is also important that you provide a different memory for each word. That means that you cannot refer to exactly the same memory or event twice. Before we begin, we will first practice with three practice words to see if everything is clear.

For every cue:
Can you recall a specific moment that the word _____ reminds you of?

Practice words: relaxation, doctor, active

Cue words:

1. disease
2. recover
3. flu
4. health
5. feverish
6. cure
7. bacterium
8. vaccination
9. headache
10. treatment

Supplemental Digital Content 2

h-RRS scale construction

Method

Participants. Analyses were conducted on a sample of first-year psychology students from University of Leuven, Belgium, who completed the questionnaire twice over a period of 6 weeks. There were 388 participants (79.9% women) at Time 1, and 341 (82.4% women) at Time 2.

Materials and procedure. The modified version of the RRS (h-RRS) consisted of items describing self-focused and symptom-focused thoughts about possible causes, meanings, and consequences of bodily sensations and symptoms. Participants rated the frequency of thoughts on a 4-point rating scale (*almost never*, *sometimes*, *often*, *almost always*).

Results and discussion

A principal component analysis with oblimin (oblique) rotation was performed. Parallel analysis method (1), which compares the size of the observed eigenvalues with the ones taken from random data, indicated a two-factor structure. A factor loading cut-off of .4 was used, and all items were retained (all loadings >.58). The first factor included items 4, 5, 6, 10, 11, and 12, while the second one consisted of items 1, 2, 3, 7, 8, and 9. The inspection of the items revealed a structure resembling the original RRS factors – brooding and reflection (2). In line with the previous findings, we interpret the first factor, which consists of the items reflecting a mental struggle against/non-acceptance of bodily sensations and complaints, as *body brooding*. The second factor includes items focused on the analysis of causes, meanings, and consequences, which was interpreted as *body reflection*. Both subscales were reliable. The coefficient alpha for the body brooding subscale was

.89 at Time 1, while for the body reflection subscale it was .87. The test-retest correlation for brooding subscale was r = .57, while for the reflection r = .51.

1. Horn J. A rationale and test for the number of factors in factor analysis. Psychometrica 1965;30:179–185.
2. Treynor W, Gonzalez R, Nolen-Hoeksema S. Rumination reconsidered: A psychometric analysis. Cognit Ther Res 2003;27:247–259.

h-RRS; Ruminative Response Scale to bodily sensations and symptoms.

People think and do many different things when **they feel bodily sensations (e.g. faster or deeper breathing while running up the stairs, faster heart rate after exercises, sensations in the stomach before or after eating, etc).** Please read each of the items below and indicate whether you almost never, sometimes, often, or almost always think or do each one when you **feel bodily sensations**. Please indicate what you generally do, not what you think you should do.

1 almost never 2 sometimes 3 often 4 almost always

h-RRS1. I think "What are the causes of these sensations?"

h-RRS2. I think "What do these sensations mean?"

h-RRS3. I think "What are the consequences of these sensations for my health?"

h-RRS4. I think "Why does this happen to me again?"

h-RRS5. I think "I wish I didn't have these sensations!"

h-RRS6. I think "I can only feel good when I don't have these sensations anymore!"

People think and do many different things when **they feel bodily symptoms (e.g. palpitations, stomach pain, dyspnea, muscle pain, headache, etc).** Please read each of the items below and indicate whether you almost never, sometimes, often, or almost always think or do each one when you **feel bodily symptoms**. Please indicate what you generally do, not what you think you should do.

1 almost never 2 sometimes 3 often 4 almost always

h-RRS7. I think "What are the causes of these symptoms?"

h-RRS8. I think "What do these symptoms mean?"

h-RRS9. I think "What are the consequences of these symptoms for my health?"

h-RRS10. I think "Why does it happen to me again?"

h-RRS11. I think "I wish I didn't have these symptoms!"

h-RRS12. I think "I can only feel good when I don't have these symptoms anymore!"

Supplemental Digital Content 3

Supplementary Table 3. Pearson product-moment coefficients (*r*) between the indices of reduced Autobiographical Memory Specificity (specific, categoric, and extended memories) and the main psychological variables (depression and rumination) for the whole sample (N=54), and the SSD (N=30) and control group (N=24) separately.

Variables	1	2	3	4	5	6	7
Whole sample (N=54)							
1. Specific memories	-						
2. Categoric memories	-.79***	-					
3. Extended memories	-.80***	.42**	-				
4. BDI-II	-.34*	.19	.30*	-			
5. RRS-brooding	-.16	.05	.11	.66***	-		
6. h-RRS brooding	-.34*	.19	.19	.73***	.75***	-	
7. h-RRS reflection	-.21	.14	.17	.57***	.49***	.61***	-
SSD patients (N=30)							
1. Specific memories	-						
2. Categoric memories	-.77***	-					
3. Extended memories	-.76***	.46	-				
4. BDI-II	-.07	-.07	.09	-			
5. RRS-brooding	.02	-.16	-.02	.60***	-		
6. h-RRS brooding	-.13	-.05	-.03	.57**	.77***	-	
7. h-RRS reflection	-.02	-.01	.03	.50**	.58**	.69***	-
Control group (N=24)							
1. Specific memories	-						
2. Categoric memories	-.70***	-					
3. Extended memories	-.73***	.14	-				
4. BDI-II	-.02	-.02	.01	-			
5. RRS-brooding	.01	.08	-.16	.51*	-		
6. h-RRS brooding	.05	.09	-.14	.54**	.50*	-	
7. h-RRS reflection	.02	-.02	-.07	.25	.00	-.03	-

Note: BDI-II = Beck Depression Inventory; RRS = Ruminative Response Scale; h-RRS = Ruminative Response Scale to bodily sensations and symptoms
* $p < .05$, ** $p < .01$, *** $p < .001$